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SOYBEANS AS A HOME-GROWN SUPPLEMENT FOR DAIRY COWS

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Soybeans, grown on the farm, give promise of providing many dairymen with a valuable protein supplement for their dairy herds which will make them independent of the purchase of high-priced protein feeds. Investigations at the Iowa Agricultural Experiment Station show that soybeans make a palatable dairy feed, that they give good results in milk production when fed in place of other protein supplements, and that pound for pound they are a third more valuable than oilmeal, with which direct comparison was made.

A home-grown supplement of that kind would be especially valuable to Iowa dairy farms. These farms easily produce all of the roughages needed for the herds in both winter and summer, such as ensilage, clover, alfalfa hay and soiling crops. It is also relatively easy for them to provide the greater portion of the grain ration, as the home-grown corn and oats should form the basis of the concentrates fed. These two feeds, however, are relatively low in protein and so are the roughages, with the exception of the legume hays. It is necessary, therefore, to secure additional concentrates which will provide the extra protein needed, especially in the ration of heavy producing cows. This is one of the main problems of dairy farming today.

This problem has in the past been met by purchasing such feeds as cotton-seed meal, linseed oilmeal and gluten feed, and it is now recognized that the best method of farming is to produce on the farm as much as possible of the feeds to be used.

Because soybeans seemed likely to be of value in this situation, the dairy section of the Iowa station carried on tests to determine the merits of the crop, thru a period of two years. Soybeans are now widely grown in Iowa for seed proposes and for putting in the silo with corn to increase the protein content of the silage. At present, the price of soybeans for seed is high, but the crop can not be grown indefinitely for this purpose.. When it has ceased to be grown to so great an extent for seed, can it be looked on as a crop which will provide a protein supplement that will render the Iowa dairy farmer less dependent on outside sources for feeds of this character?

Altho a number of comparisons between soybean meal, which is simply soybeans with the greater part of the oil ex-

tracted, and other protein supplements are to be found, yet only a few times have soybeans been compared with other feeds. Otis[1] reported that soybeans could generally take the place of oilmeal, but recommended only a small proportion of them in the ration, owing to their tendency to produce a soft butter. Both Price[2] and Cook[3] reported that soybeans and cottonseed meal were of very similar value when fed to milk-producing cows, tho the latter said that there was a slight advantage in favor of the soybeans, as he found that when cottonseed meal was worth $33 per ton, soybeans could be profitably fed when costing $41 per ton.

EXPERIMENTAL WORK WITH SOYBEANS

The two trials, No. I and No. II, were conducted in the winters of 1919-1920 and 1920-1921, respectively. The conditions under which they were carried out were kept as uniform as possible, tho the same cows could not be used each year.

Each trial was divided into three periods of 30 days each and these were again divided into subperiods of ten days each. The first subperiod of each 30 day period was looked on as a transition and the results obtained from them were not used in the final computations. Consequently, each experimental period consisted of only 20 days.

Thru each trial a basal ration of corn silage, alfalfa hay, and a grain mixture of equal parts by weight of cracked corn and ground oats was fed. In the first and third periods of each trial, old-process linseed oilmeal was fed, while in the second period cracked soybeans were used. The silage, hay, oats and corn were always of the previous year's crop, as were the soybeans. In the first trial soybeans grown especially for the purpose were used, while in the second year cull beans were fed. The soybeans were not finely ground, but were well cracked.

In feeding, the aim was to allow enough roughage for the maintenance of the animals and to feed the grain as far as possible in proportion to production. An attempt was also made to feed about two pounds of the protein supplement for each three pounds of basal grain ration fed, but this had to be varied according to the needs of the animals.

All feed given to and refused by the animals was weighed daily. The hay was fed in the morning and afternoon, while the silage and grain were fed a few hours later.

1 Otis, D. H. Experiments with dairy cows. Bull. Kans. Agr. Expt. Sta., 125, 1904.

2 Price, J. N. Home-grown rations in economical production of milk and butter. Bull. Tenn. Agr. Expt. Sta., 80, 1908.

3 Cook, A. S. Soybeans versus cottonseed meal. Rpt. N. J. Agr. Expt. Sta. 26: 293. 1913.

TABLE 1. ANALYSIS OF PROTEIN SUPPLEMENTS USED *

Trial	I		II	
Feed	Oilmeal	Soybeans	Oilmeal	Soybeans
	Percent	Percent	Percent	Percent
Moisture	10.58	9.03	7.34	5.91
Dry matter	89.42	90.97	92.66	94.09
Crude protein	34.91	37.65	30.86	37.72
Nitrogen—free extract	32.00	12.11	37.11	25.46
Crude fiber	10.31	18.78	11.06	6.30
Fat	6.63	17.00	7.55	18.94
Ash	5.57	5.43	6.08	5.67

* Acknowledgment is hereby made of the courtesy of the Chemistry section in making the determinations on the protein supplements.

The cows were watered twice daily and were weighed before and after watering. The morning weights, after feeding hay and before watering, were used to compute the average live weights of the animals. Salt in the form of blocks was kept before the animals at all times.

The animals were kept in stanchions, but were allowed to exercise daily when the weather would permit. Milking was done twice daily and a composite sample was kept for each cow for each ten-day period and tested for butterfat by the Babcock method.

The nutrients in representative samples of the two protein supplements were determined each year and it will be noted that the soybeans were somewhat higher in crude protein and fat than was the oilmeal.

TABLE II. FACTS ABOUT THE ANIMALS USED IN SOYBEAN TESTS

Trial	I				II				
Cow no.	189	225	253	356	296	298	311	356	399
Breed	Holstein	Guernsey	Grade Guernsey	Grade Guernsey	Grade Guernsey	Grade Guernsey	Grade Holstein	Grade Guernsey	Grade Guernsey
Age, Years	7	6	5	3	5	5	5	4	3
Fresh, Days	179	230	117	172	179	42	253	23	295
Previous lactations	5	3	3	0	2	3	2	1	0

The general conditions under which the trials were conducted were very similar and this renders it possible to present the data from the two trials together. In the next table, data concerning the cows used is presented and where necessary this is calculated to the date on which the trials started — January 17, 1920, for the first trial, and November 28, 1920, for the second. Four cows were used in Trial I, while five were available for Trial II.

To avoid unnecessary details, the results of the trials are summarized briefly and in making the summary for each trial, the average of the oilmeal periods in each trial has been taken

TABLE III. SUMMARY OF TRIAL I

Protein supplement	Av. live weight of cows	Feed consumed				Milk and butterfat produced		
		Corn silage	Alfalfa hay	Grain mixture	Protein supplement	Milk yield	Fat content	Fat yield
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Percent	lbs.
Oilmeal	1049	2130	420	365	213	1350.2	4.47	60.30
Soybeans	1037	2100	420	386	193	1268.1	5.12	64.90
Increase	----	----	----	21	----	-----	.65	4.60
Decrease	12	30	----	----	20	82.1	---	----
Increase percent	----	----	----	6	----	-----	15	8
Decrease percent	1	1	----	----	9	6	---	----

as a basis with which to compare the soybean period which was between them.

In the first trial there was a negligible variation in the weight of the animals and in the roughages consumed. There was, however, an apparent variation in the total amount of concentrates used (an increase of six percent in the grain mixture and a decrease of nine percent in the protein supplement), but when the mixed grains and the protein supplement are grouped together it is found that only one pound more grain was fed during the soybean period than in the average of the other two.

During the second trial no variation occurred in live weight or in the consumption of grain, but there was six percent less silage and seven percent less hay consumed when soybeans were fed.

When production is considered, it is found that in both trials there is a decrease in milk yield, but an increase in the percentage and yield of fat when soybeans were fed. As the other factors remained quite uniform, this may be considered as significant, especially in so far as the butterfat yield is concerned. The increase in the butterfat yield was eight percent and seven percent in the first and second trials respectively.

TABLE IV. SUMMARY OF TRIAL II

Protein supplement	Av. live weight of cows	Feed consumed				Milk and butterfat produced		
		Corn silage	Alfalfa hay	Grain mixture	Protein supplement	Milk yield	Fat content	Fat yield
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	Percent	lbs.
Oilmeal	988	2512	596	598	398	2134.1	4.19	89.45
Soybeans	987	2369	557	598	398	2076.9	4.62	96.04
Increase	----	----	----	----	----	-----	.43	6.59
Decrease	1	143	39	----	----	57.2	---	----
Increase percent	----	----	----	----	----	-----	10	7
Decrease percent	----	6	7	----	----	3	---	----

TABLE V. TOTAL FEED CONSUMPTION AND MILK AND BUTTERFAT PRODUCTION

Feed and produce	Oilmeal periods	Soybean periods
	lbs.	lbs.
Corn silage	4642	4469
Alfalfa hay	1016	977
Cracked corn	482	492
Ground oats	482	492
Oilmeal	611	----
Soybeans	----	591
Milk	3484.3	3345.0
Butterfat	149.75	160.94

DISCUSSION OF RESULTS

It would appear from the work reported here that cracked soybeans give somewhat greater returns in the form of butterfat than does oilmeal when fed to cows as a protein supplement to a home-grown ration of corn silage, alfalfa hay, corn and oats. The most important point, however, is to determine the value that can be put on cracked soybeans as compared with oilmeal. For this purpose the results of the two trials are combined.

In determining the relative money values of the two supplements the costs of the various feeds were taken as those current at the time of the compilation of the results, August, 1921.

When using the prices given, it is found that the total cost of feed in the oilmeal periods is $43.96 for the production of 3484.3 pounds of milk, containing 149.75 pounds of fat. In other words, the feed cost of production is $1.27 per 100 pounds of milk, or 29.4 cents per pound of butterfat.

In the cracked soybean periods, 3345.0 pounds of milk, containing 160.94 pounds of fat, was produced. Taking a feed cost of production for this fat the same as that obtained in the oilmeal periods, it is found that the total feed cost of the butterfat would be $47.32. The feeds other than soybeans accounted for $29.55 of this cost, so when this sum is subtracted from the total feed cost there is left a balance of $17.77, which is the value of the 591 pounds of cracked soybeans fed. In other words, when old-process linseed oilmeal is worth $45 per ton, then cracked soybeans fed under the same conditions have a value of $60 per ton, or the cracked soybeans were one-third more valuable than the oilmeal.

TABLE VI. COST OF FEEDS

Feed or product	Price per ton
Corn silage	$ 5
Alfalfa hay	20
Cracked corn	20
Ground oats	15
Oilmeal	45

SUMMARY

In the trials discussed, cracked soybeans proved to be worth $60 per ton for the feeding of milk cows when old-process linseed oilmeal was worth $45 per ton, and so they prove to be a valuable supplement to a home-grown ration of corn silage, alfalfa hay, cracked corn and ground oats. In other words cracked soybeans, when fed with the home-grown ration mentioned, are worth one-third more than oilmeal. The soybeans were palatable and had no deleterious effects on the animals. Consequently, it would appear that soybeans if grown more extensively, not only for seed purposes or for the purpose of adding protein to silage, would be a valuable home-grown protein supplement and would render many dairymen independent of the purchase of high-priced protein feeds. In this way it would be possible to conduct a dairy farm with the use of practically no purchased feeds.